Occupational Diseases: Working with Dangerous Chemicals

Historically, the weighing out and manipulation of dangerous chemicals frequently occurred without adequate protection from inhalation or accidental ingestion. The use of gloves, eye protection using goggles, masks or visors was scant.

**Dangerous chemicals**

Examples of common dangerous chemicals in the laboratory include the following:
- Benzidine: Used to detect blood
- Saponin: Non-ionic surfactant irritant/blood lytic agent
- Sudan black: Fat stain. Irritant and damaging when ingested
- Glutaraldehyde/formaldehyde: Irritants and possible carcinogens
- Alpha-naphthol: Carbohydrate detection
- Possible bladder carcinogens

**Carcinogens in the workplace**

A number of identified carcinogens have been identified in industrial processes and other occupations. The table below lists those positively identified and their sources.

<table>
<thead>
<tr>
<th>Carcinogenic agent</th>
<th>Disposition/process</th>
<th>Cancer type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asbestos</td>
<td>Construction, electrical, shipyard, old floor tiles</td>
<td>Lung, stomach</td>
</tr>
<tr>
<td>Benzene</td>
<td>Foundry work</td>
<td>Leukemia</td>
</tr>
<tr>
<td>Benzyldiphenylamine</td>
<td>Road maintenance, construction</td>
<td>Lung</td>
</tr>
<tr>
<td>Coal tar/pitch</td>
<td>Laboratories, textile and wood industries</td>
<td>Skin, bladder</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td></td>
<td>Mononuclary</td>
</tr>
<tr>
<td>In vivo radiation</td>
<td>Radiotherapy, nuclear industry</td>
<td>Bone, brain, liver, bladder</td>
</tr>
<tr>
<td>Mineral oils</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radar (naturally occurring)</td>
<td>Quenchers, mines</td>
<td>Lung</td>
</tr>
<tr>
<td>Certain pesticides</td>
<td>Farming industry</td>
<td>Skin, lymphatics</td>
</tr>
<tr>
<td>Silica dust</td>
<td>Construction, mining</td>
<td>Lung</td>
</tr>
<tr>
<td>Tetrachloroethylene</td>
<td>Painters</td>
<td>Non-Hodgkin’s lymphoma, cervix</td>
</tr>
<tr>
<td>Vinyl chloride</td>
<td>Refrigerants, adhesives</td>
<td></td>
</tr>
<tr>
<td>Wood dusts</td>
<td>Construction, wood mills</td>
<td>Mononuclyr</td>
</tr>
</tbody>
</table>

**Working with carcinogens**

- Carcinogenic agents are chemicals with the potential to cause cancer by inducing genetic mutations and thus promote the formation of tumours.
- Over 900 chemicals have been assessed over a period of 30 years and around 100 have been confirmed as causing cancer in humans.
- It is estimated that around five percent of cancer-related deaths are attributable to occupational exposure to carcinogens.

**Ames method**

- Bruce Ames, the American biochemist, developed a bacterial procedure using cultures of Salmonella typhimurium in the early 1970s to identify carcinogens (Nicoson et al. 1975).
- The organism used had a mutation so that cultures required histidine to grow.
- The addition of rat liver homogenate and a possible carcinogen could induce a mutation thus increasing the number of colonies.
- Ames’ early studies of almost 200 suspect chemicals gave a 90% positive result rate.

**Evidence of carcinogenicity**

Evidence of carcinogenicity has been determined in the past by animal studies and, more recently, by cell culture studies. These chemicals giving rise to cancer in animals also give rise to cancer in humans, although differences in dosages were often apparent.

**Use of epidemiological studies**

- Controlled studies of comparative frequency of cancer in the workplace using a control group is compared to the frequency in the general population.
- This, however, may be limited by unworkplace exposures and the need for long-term studies as long periods of time may occur between exposure and the development of cancer (e.g. bladder cancer).

**Prevention of disease caused by heavy metals**

**Monitoring exposure**

- Materials analysis: determining the metal content of raw materials.
- Air monitoring: using the measurement of the concentration in the workplace air.
- Biological monitoring: the most recent measurements used, involving the assessment of blood levels in industrial workers.

**Development of the fume cupboard/hood**

- In 1950, J. H. Sholto-Douglas, described the first practical fume cupboard for the laboratory.

**Developments in carcinogen history**

**The 1700s**

- Diseases of workers (published in 1760 by Runnymede in Italy) was the first comprehensive work on the occupational diseases, outlining the health hazards of imitation chemicals, dust, metals and other agents encountered by workers in 52 different occupations.
- Snuff (a product of tobacco) was shown by John Hill to be a possible cause of nasal cancer in 1773.
- Percival Pott, in 1775, associated scrotal cancer in chimney sweeps with soot, leading to the chimney sweep Act of 1788.

**The 1800s**

- Benzene, a known carcinogen, was isolated for the first time in 1825.
- Bladder cancer was described by the industry workers by Ludwig Meyn in 1895.

**The 1900s**

- In 1902, the atomic emission theory was published by Theodor Exner.
- Official compensation was approved in 1907 for skin cancer sufferers handling tar or pitch.
- Painted coal tar associated with cancer in 1915 and the occupational development of cancer became a noticeable condition in 1920.
- Luminous paint containing radium, dermatochromes, benzylpyryldiamines, and benzylidene in cancer cases between 1922 and 1925.
- Asbestos as the cause of mesothelioma described in 1910 by J. Wagner.
- Carcinogenic Substances: Regulations published in 1927.
- Hepatitis B was identified as a trigger for hepatocellular carcinoma by Politzer Besbrody in 1981.
- Hepatitis C identified as a cause of liver cancer (Michaels, 1999).
- Smoking as a cause of lung cancer delineated in 1959.